MASTER OF SCIENCE
IN
PHYSICS

MODELING TOTAL DOSE RADIATION EFFECTS IN A MULTI-EDGE SOI nMOSFET

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Silicon-On–Insulator (SOI) devices provide inherent radiation-hardness for dose-rate and single-event upset effects that makes them ideally suited for radiation environments such as space. Specifically, the SOI Metal-Oxide-Semiconductor Field Effect Transistor (MOSFET), with its many Si/SiO_2 interfaces, is normally only sensitive to total dose radiation effects. This thesis investigates how to model these effects accurately and develops a computer simulation methodology utilizing hole trapping for modeling total dose radiation effects in a SOI semiconductor device. Specifically, a commercial Technology Computer Aided Design (TCAD) application, modified to include total dose radiation effects, is used to simulate an irradiated n-channel, multi-edge SOI MOSFET. The accuracy of the model is evaluated by using the simulation data to calculate simplified radiation induced leakage currents at various radiation dosages and then comparing with experimental measured leakage currents from irradiated devices. Simulation results show that while hole trapping is a dominant mechanism in causing enhanced leakage current at lower dose levels, it cannot solely account for all the enhanced leakage that occurs in a multi-edge device at higher dose levels.

DoD KEY TECHNOLOGY AREAS: Electronics, Modeling and Simulation

KEYWORDS: Electronics, Silicon-on-Insulator (SOI), Modeling and Simulation, Radiation Hardened

SIMULATION OF DARMSTADT FREE ELECTRON LASER AND
A COMPARISON OF HIGH GAIN FREE ELECTRON LASERS

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The Free Electron Laser, with its wavelength tunability unlike any other laser, may be used in numerous future applications. These applications range from high energy laser weapons to surgical lasers for medical use. This thesis covers three separate topics concerning the FEL: the height of the separatrix for a tapered undulator, use of dimensionless parameters in a simple model and description for several high gain free electron lasers, and simulations of the Darmstadt free electron laser. The first topic yielded a formula for the separatrix height. The second topic utilized data from the proposed LCLS and TESLA x-ray lasers, the Electron Laser Facility at Lawrence Livermore Labs and the Free Electron Laser experiments at the Massachusetts Institute of Technology to develop dimensionless parameters for use in a simple model. For the last topic desynchronism curves for seven tapers were computed and gave expected results.

DoD KEY TECHNOLOGY AREAS: Directed Energy Weapons, Modeling and Simulation

KEYWORDS: Free Electron Laser

EFFECTIVENESS OF MODELING A HIGH POWER RADIO FREQUENCY (HPRF) WEAPON SYSTEM (U)

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The objective of this research was to model the electromagnetic output of a proposed High Power Radio Frequency (HPRF) weapon system. The antenna data was generated using GNEC, a method of moments computational electromagnetic code. The impulsive excitation and resultant transient near-fields were modeled using electrical circuit analysis and inverse Fast Fourier Transformation programmed in MATLAB 5.3. The peak amplitudes and waveforms were the primary focus of this study

DoD KEY TECHNOLOGY AREAS: Electronics Warfare, Directed Energy Weapons, Modeling and Simulation
KEYWORDS: Electronic Warfare, Directed Energy Weapons, Antenna Design, Antenna Modeling, Electromagnetic Simulation